AMERICAN MANUFACTURING COMPANY

www.american-manufacturing.com

DUPLEX POWER PUMP

AMERICAN MANUFACTURING MODELS:

AXF - 5”

AXG - 6”

GARDNER DENVER MODELS:

FXF - 5”

FXG - 6”

FXX - 8”

FXD - 10”

FXE - 10”

OPERATING AND SERVICE MANUAL

PERRY JOHNSON REGISTRARS, INC.

UKAS MANAGEMENT SYSTEMS

7k-0266

MGMT. SYS. RvA C 118

ANAB ACCREDITED

ISO 9001:2008 Registered

MAINTAIN PUMP RELIABILITY AND PERFORMANCE WITH GENUINE AMERICAN MANUFACTURING COMPANY PARTS AND SUPPORT SERVICES

American Manufacturing Company genuine pump parts, manufactured to design tolerances, are developed for optimum dependability. Design and material innovations are the result of years of experience with hundreds of different pump applications. Reliability in materials and quality assurance are incorporated in our genuine replacement parts.

Your authorized American Manufacturing Company distributor offers all the backup you'll need. A worldwide network of authorized distributors provides the finest product support in the pump industry.

Your local authorized distributor maintains a large inventory of genuine parts and he is backed up for emergency parts by direct access to the American Manufacturing Company Master Distribution Center (MDC) in St. Joseph, Minnesota.

Your authorized distributor can support your American Manufacturing Company pump needs with these services:

1. Trained parts specialists to assist you in selecting the correct placement parts.
2. Repair and maintenance kits designed with the necessary parts to simplify servicing your pump.

Authorized distributor service technicians are factory-trained and skilled in pump maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair services.

For the location of your local authorized American Manufacturing Company distributor refer to the yellow pages of your phone directory or contact:

Factory:
American Manufacturing Company
736 19th Avenue NE
PO Box 640
St. Joseph, MN 56374
www.american-manufacturing.com
Phone: (320) 363-7273
Fax: (320) 363-7274

Distribution Center:

INSTRUCTIONS FOR ORDERING REPAIR PARTS

When ordering parts, specify Pump MODEL and SERIAL NUMBER (see nameplate on unit). The Serial Number is also stamped on top of the cylinder end of the frame (cradle area).

All orders for Parts should be placed with the nearest authorized distributor.

Where NOT specified, quantity of parts required per pump or unit is one (1); where more than one is required per unit, quantity is indicated in parenthesis. **SPECIFY EXACTLY THE NUMBER OF PARTS REQUIRED.**

DO NOT ORDER BY SETS OR GROUPS.

To determine the Right Hand and Left Hand side of a pump, stand at the power end and look toward the fluid end. Right Hand and Left Hand are indicated in parenthesis following the part name, i.e. (RH) & (LH), when appropriate.

FOREWORD

American Manufacturing Company pumps are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenance information which is important but not hazard-related.

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SECTION 1
DANGER NOTICES

⚠ DANGER

Read and understand the following DANGER NOTICES before moving or operating the pump or any pump packing unit equipment.

Reciprocating pumps are machines capable of producing high fluid pressures and flow rates and are designed to be used with prosper care and caution by trained, experienced operators. **TO AVOID PERSONAL INJURY, DEATH AND/OR EQUIPMENT DAMAGE, READ AND THOROUGHLY UNDERSTAND THE FOLLOWING DANGER NOTICES PLUS THE ENTIRE OPERATING AND SERVICE MANUAL BEFORE ATTEMPTING TO MOVE OR OPERATE THE PUMP.** Contact an American Manufacturing Company service representative if you are unable to comply with any of the danger notices or procedures described in these documents.

Closely examine the data plate upon pump delivery to become thoroughly familiar with the operating limits for this pump model. **The pump must <u>never</u> be operated at speeds, pressures or horsepower exceeding the maximum values shown on the data plate or at speeds below the minimum shown. Failure to observe the operating limits shown on the data plate could result in personal injury, death, and/or equipment damage and will void the warranty.** Alterations to the pump, or application of the pump outside the data plate limits, must not be made without American Manufacturing Company written approval together with a new data plate, as dangerous operating conditions could result.

THE DANGER NOTICE AND DATA PLATES PROVIDED ON THE EQUIPMENT MUST NOT BE REMOVED, PAINTED OVER, HIDDEN OR DEFACED. They must be replaced if they become damaged or unreadable. Provisions should be made to have the following written danger notices plus the pump operating and service manual readily available to operators and maintenance personnel. In addition, copies of all pump system accessory component (e.g. pressure relief valve, pulsation dampener, suction stabilizer, engine, electric motor, etc.) operating and service manuals should be readily available for operator and maintenance personnel use. Read and follow all the precautions and instructions contained in these manuals. If any of these documents are lost or become illegible they must be replaced immediately. The danger notices plus the operating and service manuals should be reread periodically by both operators and maintenance personnel to refresh their memories in safe procedures and practices.

Keep in mind that full operator attention and alertness are required when operating high pressure pumping equipment. Operators should not begin or continue operations when tired, distracted or under the influence of alcohol or any type of prescription or nonprescription drugs.

The timely replacement of expendable parts and any other worn or damaged parts can prevent equipment damage and possible injury. The original parts used in American Manufacturing Company pumps are designed and tested to exacting standards to provide high quality performance and durability. Your best insurance in maintaining these characteristics is to use genuine American Manufacturing Company replacement parts.

A broad range of danger notices are covered on these pages, however, they cannot substitute for training, experience and common sense in the safe operation of high pressure pumping equipment.

<u>HAMMER LUG FASTENERS</u>

⚠ DANGER

On pumps or pump packing units equipped with hammer lug connectors and/or hammer lug valve covers the following precautions must be observed to avoid personal injury, death and/or equipment damage due to contact with the hammer, hammer bar, broken parts from the hammer, hammer bar or lugs or other objects propelled by hammer blows. When tightening or loosening hammer lug connectors and valve covers, operators or maintenance personnel should:

- Inspect the hammer, hammer lugs and hammer bar, if one is used, to insure they are all in good condition. Replace any of these parts which are cracked, damaged or badly worn.
- Wear safety shoes and goggles.
- Alert other personnel to move away from the area.
- Check to insure they have safe footing.
- Fully engage the hammer bar, if one is used, to prevent it from disengaging violently from the cover as a blow is struck.
- Wipe their hands and the hammer handle and maintain a firm grip on the handle to avoid losing control of the hammer while swinging and striking.

- Carefully swing the hammer to avoid striking themselves, another person and objects other than the targeted lugs or hammer bar.
- Avoid swinging the hammer above shoulder height.

VALVE SEAT PULLING

⚠ DANGER

The following precautions must be observed by operators and maintenance personnel to avoid personal injury, death and/or equipment damage from contact with the puller, hammer, wedge or broken parts from these components when using either a hydraulic or wedge valve seat puller:

Hydraulic Puller

- Wear safety shoes and goggles.
- Chain or tie the jack down as it will jump violently when the valve seat disengages from the valve deck.
- Check to insure the pressure applied by the hydraulic pump does not exceed the hydraulic ram maximum pressure rating.

Wedge Puller

- Grind off any mushroomed material from the wedge before use.
- Follow the danger notices listed above in the hammer lug section, but substitute the term wedge for hammer lug and hammer bar.

COVERS AND GUARDS

⚠ DANGER

All pump covers must be securely fastened in proper position at all times when the pump is operating to avoid personal injury or death from moving parts. In addition, all moving parts on the entire pump package, including but not limited to engine or motors, drive shafts, belts, chains, pulleys, gears, etc., must be equipped with guards or covers, which must also be securely fastened in proper position at all times when the equipment is operating.

Covers and guards are intended to not only protect against personal injury or death, but to also protect the equipment from damage from foreign objects.

EQUIPMENT MOVING AND LIFTING

⚠ DANGER

Heavy equipment including pumps, pump package units and components should only be moved or lifted by trained, experienced operators, who are physically and mentally prepared to devote full attention and alertness to the moving and lifting operations. An operator should be fully aware of the use, capabilities, and condition of both the equipment being moved and the equipment being used to move it.

⚠ DANGER

Failure to follow safe and proper pump, pump package or component lifting or moving procedures can lead to personal injury, death and/or equipment damage from shifting, falling or other unexpected or uncontrolled equipment movements.

Make sure the hoist, lift truck, ropes, slings, spreader, or other lifting equipment you are using is in good condition and has a rated lifting capacity equal to or greater than the weight being lifted. Lifting devices must be checked frequently for condition and continued conformance to rated load capacity. They should then be tagged with the inspected capacity together with the date of inspection.

Fully assembled pumps and pump package units are heavy and should not be moved using the specified lifting lugs or attachments. **Many individual components have lifting eyes or lugs which must not be used to lift assemblies, as they are designed to bear the weight of the component only.** Before lifting the individual component check to ensure the lifting attachment is firmly secured to the component with undamaged, properly torqued fasteners, sound welds, or other secure attachments. Examine the lifting eyes, lugs, slots, holes or other projections to insure they are not cracked, otherwise damaged or badly worn. The repair of existing or addition of new welded lifting eyes, lugs or other projections should only be performed by experienced, qualified welders.

Package units should be lifted with spreaders connected to the lifting attachments normally built into the package unit support skid. Packages too large to lift fully assembled should be separated into smaller loads.

For these smaller loads the lifting devices should be fastened to the lifting attachments normally built into the individual motor, engine, pump or transmission/ torque converter, or their separate support skids.

When lifting subassembled components, for example a suction stabilizer attached to suction piping or a discharge pulsation dampener attached to a strainer cross and piping, use special lifting slings designed to safely support the combined weight of the components.

If a crane or hoist is being used to lift large components or assemblies, one or more persons should assist the operator from the ground with guide lines attached to the equipment being moved to properly position it and prevent uncontrolled movement.

When you start to lift a pump, package unit, subassemblies or individual components and you observe the equipment is tilting, or appears unbalanced, lower the equipment and adjust the lifting device to eliminate these improper lifting conditions before proceeding to move the equipment.

It is poor practice and dangerous to allow the equipment to pass over or close to your body or limbs. Be prepared to move quickly out of danger if equipment starts to fall, slip or move unexpectedly toward you.

PRESSURIZED PUMP SYSTEMS

⚠ DANGER

Fluids under high pressure can possess sufficient energy to cause personal injury, death and/or equipment damage either through direct contact with escaping fluid streams or by contact with loose objects the pressurized fluid propels.

Operating a pump against a blocked or restricted discharge line can produce excessive pressures in the entire discharge system, which can damage or burst discharge system components.

⚠ DANGER

Never operate a pump without a properly sized pressure relief valve located in the flowing discharge line immediately adjacent to the pump discharge connection.

The relief valve should be placed in the flowing discharge line and not at the opposite end of the discharge manifold in a dead end connection. The dead end may become clogged with solid material carried in the fluid, which could prevent proper relief valve operation.

⚠ DANGER

Never place a shut-off valve or any other component between the pump discharge connection and the pressure relief valve.

Make sure the pressure relief valve is installed so any pressurized relief discharge from the valve is directed away from possible contact with people or equipment. The relief valve must be set to relieve at a pressure equal to or below the maximum pressure values shown on the pump data plate. However, if a component is used in the discharge system with a lower rated pressure capability than that listed on the pump data plate, the pressure relief valve must be set to relieve at a pressure equal to or below the rated capability of the lowest rated component.

Before starting the pump every time, check to insure:

- The pressure relief valve is in good operating condition and has been set to the proper relief pressure.
- Any pipe line used to direct pressurized relief flow to another location, such as a collecting tank, is not blocked.
- The discharge system is not blocked and all the discharge line valves are open.

Check all fluid end discharge system components including pipe, connections, elbows, threads, fasteners, hoses, etc., at least once every six months to confirm their structural adequacy. With time, wear, corrosion and fatigue can reduce the strength of all components. Magnetic iron and steel components should be checked with magnetic particle or dye penetrant crack detection equipment. Nonmagnetic materials should be checked for cracks with dye penetrants. All metallic components should also be visually checked during these inspections for signs of corrosion. If a component shows evidence of cracking or loss of material due to corrosion it must be replaced with a new part.

Continually monitor suction and discharge hose assemblies when the pump is operating for leakage, kinking, abrasion, corrosion or any other signs of wear or damage.

Worn or damaged hose assemblies should be replaced immediately. At least every six months examine hose assemblies internally for cut or bulged tube, obstructions and cleanliness. For segment style fittings, be sure that the hose butts up against the nipple shoulder, the band and retaining ring are properly set and tight and the segments are properly spaced. Check for proper gap between nut and socket or hex and socket. Nuts should swivel freely. Check the layline of the hose to be sure that the assembly is not twisted. Cap the ends of the hose with plastic covers to keep them clean until they are tested or reinstalled on the pump unit. Following this visual examination, the hose assembly should be hydrostatically tested, on test stands having adequate guards to protect the operator, per the hose manufacturer's proof test procedure.

Fluid end component inspections should be performed more frequently than every six months if pressures about 2500 psi are used in the discharge system or if corrosive, flammable or hot (over 110° F) fluids are being pumped.

Proper stuffing box packing selection is important for safe pump operation. Contact a American Manufacturing Company service representative for assistance in selecting the proper packing before beginning operation.

Before starting the pump for the first time and periodically thereafter check the pump, suction and discharge system fastener torques versus the values listed in the Operating and Service Manual tables to insure proper tightness. Over and under torquing can damage threaded pipes, connections and fasteners, which may lead to component damage and/or failure. Replace all components found to be damaged or defective. On pumps equipped with stuffing boxes, the gland must be engaged by at least three (3) threads to hold the discharge pressure of the pump.

⚠ DANGER

Do not attempt to service, repair, adjust the plunger packing for otherwise work on the pump while the unit is operating. Shut off the pump drive motor or engine and relieve the fluid pressure in the pump suction and discharge systems before any work or investigation is performed on the pump or pump systems.

Block the crankshaft from turning and make certain that all pump drive motor or engine start switches or starter controls are clearly tagged with warnings not to start the pump while repair work is in process.

Whenever the pump is operating, continually monitor the entire suction, discharge and pump lubricating system for leaks. Thoroughly investigate the cause for leakage and do not operate the pump until the cause of the leak has been corrected. Replace any parts which are found to be damaged or defective. When a gasketed joint is disassembled for any reason, discard the used gasket and replace it with a new, genuine American Manufacturing Company gasket before reassembling the joint.

Due to the high working pressures contained by the fluid cylinder, discharge manifold and discharge piping, welding on these components is not recommended. If welding on the discharge system cannot be avoided, only experienced, qualified welders should be used. In addition, the welded part should by hydrostatically proof tested in the shop with water or hydraulic fluid to one and one half times maximum discharge system working pressure, with no observable fluid leakage, before the part is reinstalled in the pump system.

In summary, high pressure fluid streams can possess sufficient energy to cause personal injury, death and/or equipment damage. These results can occur either through direct contact with the fluid stream or by contact with loose objects the fluid stream has propelled, if the pump system is improperly used, or if the fluid is misdirected, or allowed to escape from defective or improperly maintained equipment.

FLAMMABLE, HOT, COLD OR CORROSIVE FLUID PUMPING

⚠ DANGER

Extreme caution must be exercised by trained and experienced operators when flammable, hot, cold or corrosive fluids are being pumped, in order to avoid personal injury, death and/or equipment damage due to explosion, fire, burn, extreme cold or chemical attack.

Never operate a pump which is pumping hydrocarbons or other flammable, hot, cold, or corrosive fluids when any part of the pump, suction system or discharge system is leaking. Stop the pump immediately if any leakage, other than a few drops per minute of packing weepage, is observed. Keep all flame, sparks, or hot objects away from any part of the pump, suction system, or discharge system. Shield the pump, suction system and discharge system to prevent any flammable, hot, cold or corrosive fluid leakage from dripping or

spraying on any components, flame, sparks, hot objects or people. Inspect the plungers, packing, gaskets and seals for fluid leakage frequently and replace all worn or leaking parts.

Selection of the proper gaskets, seals and stuffing box packing is even more critical when flammable, hot, cold or corrosive fluids are being pumped than when other, inherently less dangerous fluids are used. Contact a American Manufacturing Company service representative for assistance in selecting the proper gaskets, seals and packing before beginning of operation.

Since some packing seepage into the cradle area is inevitable, the drain at the bottom of the cradle must be connected to a drain line which conducts the fluid leakage to a collection container located in a protected area. The entire drain system and container must be constructed of materials resistant to attack from the pumped fluid or from explosion or fire of the pumped fluid. **Heavy duty cradle covers must be securely fastened in the proper position on the pump at all times when the pump is operating. If the pumped fluid is releases harmful, explosive or flammable vapors the covers must be vented to conduct the fumes away from the pump unit to a nonhazardous area.**

Before beginning pumping operations or starting the pump power source (whether an engine or electric motor) check the atmosphere all around the pumping site for the presence of flammable or explosive vapors. Do not begin operation and stop ongoing operation if flammable or explosive vapors are detected. Hot surfaces, sparks, electric current or engine exhaust could ignite flammable or explosive vapors. Each engine used as a power source on pumping units where flammable or explosive vapors could form should be equipped with an air inlet shut-off. If flammable or explosive vapors are present in the pumping site atmosphere, an engine could continue to run on these vapors even after the engine fuel line is shut-off if an air inlet shut-off is not used.

In addition, on pumping units used where flammable or explosive vapors could form, all electric motors used as power sources must be explosion proof construction and all electrical components and wiring must meet the current National Electrical Code for explosive atmospheres.

These precautions must be taken to avoid possible personal injury, death and/or equipment damage from explosion, fire or burns.

HIGH PRESSURE LIQUID ,JETTING, BLASTING AND CLEANING

⚠ DANGER

Extreme caution must be exercised if any type of wand, gun, nozzle or any other pressure and flow directing device is attached to the pump discharge system for use in jetting, blasting, cleaning, etc. This type of equipment must be used with utmost care by trained, experienced operators. High pressure fluid streams can either by direct contact of by propelling loose objects, cause serious personal injury or death to the operators and/or other persons.

Pressure or flow directing devices often receive pressurized flow through flexible hoses, which can burst if they are kinked, cut, abraded or are otherwise worn, damaged or pressured above their rated capacity. Protect the hose and connections from damage by people, objects and vehicles. A broken, cut or otherwise burst hose can release pressurized fluid which may cause personal injury, death and/or equipment damage.

High pressure fluid from hand held or hand directed pressure and flow directing devices may overpower an operator's ability to control or direct the device, which could lead to personal injury, death and/or equipment damage. The operator must brace against the backward thrust of a hand held device. In addition, a safety harness or safety net must be used when working in an area where the operator could be injured in a fall. Stand to the side of any tubing or container being sprayed to avoid back spray and never operate a hand held device above shoulder level.

Never direct the pressurized fluid stream at yourself or any other person, control valves, the pump, pump drive, suction or discharge systems. The pressurized stream can cause serious personal injury or death and can also change valve or control settings which could dangerously increase the delivery pressure to the pressure and flow directing device.

When operating a pressure and flow directing device, use only equipment which automatically shuts off flow when an operator releases hand or foot pressure on the pressurized flow trigger control to prevent injury if the operator is overpowered or becomes disabled.

Check to insure this automatic shut-off equipment is operating properly before every use and never circum-

vent the automatic shut-off for any reason or by any means when operating the equipment.

When operating any type of high pressure liquid jetting, blasting or cleaning devices the operators must always wear protective clothing including, but not limited to, a hard hat with full face visor, heavy duty rain coat and pants, boots with nonskid sole and safety toe, rubber gloves with rough grip surface and ear noise protection.

Full operator attention and alertness are required when operating this equipment to avoid personal injury, death and/or equipment damage. The operators should take frequent rest breaks and cease operations when they become tired or distracted.

Before the equipment is started, the work area must be inspected and properly prepared to avoid personal injury, death and/or damage to equipment. Make sure the work area is checked for hazardous fumes, has adequate ventilation for engine exhaust and sufficient drainage for released fluid. Check the work area for electrical equipment, connections, outlets, fixtures, or lines. If any are present they must be made water tight and the electrical power to these devices must be shut off to avoid electrical shocks from fluid contact. The work area should be clearly marked and roped off to keep unauthorized people and vehicles from entering. Remove all loose parts, tools and equipment from the work area before beginning operation.

All pressure containing devices including wands, nozzles, guns, hoses, connections, etc., should be regularly checked for condition. These components should all be tagged with their tested pressure capabilities together with the date testing was performed. **Always be aware of the pressure level in the system and never connect any equipment to the system which has a rated or tested pressure capability below the system operating pressure.** The equipment must be shut down and the system pressure released before changing or disconnecting wands, nozzles, guns, hoses, connections or any other pressurized system components.

All pressure containing devices including wands, nozzles, guns, connections, etc., plus all automatic shut-off, pressure and control equipment should be treated with care. Protect them from damage by people, objects and vehicles. **Never** lay them in dirt, mud, ice or other loose material which could plug the fluid opening or interfere with their operation. **Never** use the wand, nozzle, gun, etc. to pry loose material off items being cleaned.

Before starting operation in a cold environment, check to make sure there is no ice in the fluid system. Repeat this inspection each time before operation is restarted.

Before purchasing wands, nozzles, guns, connections, and hose, etc., manufacturers of these components should be contacted for detailed information on the design and safety features incorporated in their products. After careful study of various manufacturers products, we recommend that **only** those wands, nozzles, guns, connections and hose, etc., be considered for purchase that you judge to offer the highest quality of design, construction and safety, since these components are among the most critical to the safe operation of high pressure liquid jetting, blasting and cleaning equipment.

After you have selected and purchased these components, follow the manufacturer's instructions completely in their use.

In summary, high pressure jetting, blasting and cleaning are inherently dangerous, as the pressures and flow rates need to remove scale, clean, etc. are sufficient to cause personal injury, death and/or equipment damage resulting from, but not limited to, any of the conditions described in the above Danger Notices.

SECTION 2
INSTALLATION & OPERATING INSTRUCTIONS

FOR AMERICAN MANUFACTURING AXF, AXG & GARDNER DENVER FXF, FXX, FXD AND FXE DUPLEX POWER PUMPS

INSTALLATION – The pump should be installed as close to the fluid supply as possible. Whenever possible, ample space should be provided around the pump to facilitate inspection and adjustment with particular attention to the space required for removal and installation of piston rods, liners and jackshafts.

Pump should be properly leveled and securely fastened to whatever type of foundation is provided and drive must be accurately aligned.

PIPING

> **⚠ CAUTION**
>
> **All piping must be supported independently of the pump to insure that no strain is imposed on the pump by misalignment or improperly fitted pipe.**

Fluid Inlet or Suction Piping – Inlet piping should be as direct and short as possible and should be laid out so that air pockets are eliminated. The inlet pipe must never be smaller than the pump inlet and lines longer than 20 feet (6 meters) (including friction) must never be exceeded. To protect the pump from foreign matter, an inlet strainer should be installed with a net area of four times the inlet pipe.

Fluid Discharge Piping – It is advisable to use an ample size discharge line to prevent excessive friction. The use of an air chamber is recommended and ample size chambers are available for all pumps.

RELIEF VALVE - Pump must be protected from excess pressure by a discharge pressure relief valve. The valve must be installed near the pump, preferably in the opening provided for it in the discharge manifold on models where applicable. Never install a shutoff valve in the line between the relief valve and pump cylinder. The relief valve should be set to operate at approximately 1-1/4 times the discharge pressure, but must not exceed system equipment tolerances.

CRANKCASE OIL REQUIREMENTS

API-GL5 Oil Grade	Ambient Temperature	Crankcase Operating Oil Temperature *	Minimum Startup Oil Temperature
75W-90	-20˚ F to 90˚ F (-29˚ C to 32˚ C)	60˚ F to 170˚ F (16˚ C to 77˚ C)	20˚ F (-7˚ C)
80W-140	10˚ F to 120˚ F (-12˚ C to 49˚ C)	90˚ F to 200˚ F (32˚ C to 93˚ C)	50˚ F (10˚ C)
80	-10˚ F to 60˚ F (-23˚ C to 16˚ C)	70˚ F to 140˚ F (21˚ C to 60˚ C)	30˚ F (-1˚ C)
90	20˚ F to 100˚ F (-7˚ C to 38˚ C)	100˚ F to 180˚ F (38˚ C to 82˚ C)	60˚ F (16˚ C)
140	50˚ F to 120˚ F (10˚ F to 49˚ C)	130˚ F to 200˚ F (154˚ C to 93˚ C)	80˚ F (27˚ C)

* An 80˚ F (27˚ C) crankcase oil temperature rise over ambient air temperature is typical for the pumps covered by this manual when operating at or near rated horsepower.

FIGURE 1 – CRANKCASE OIL REQUIREMENTS

⚠ DANGER

Improper use or maintenance of relief valves can cause excessive pressure which may result in property damage and/or serious personal injury or death.

When the pump is equipped with Shear Type Relief Valve, use only one Shear Pin of the size shown on the setting plate. The use of a nail or any shear device other than Vendor Shear Pin may be extremely hazardous. Do not hammer on the shear bar or stem or shear bar slot.

LUBRICATION – Recommended crankcase oils are as shown in FIGURE 1, page 7.

Oil viscosity must not exceed 7000 SSU at startup and must be between 1500 SSU and 130 SSU while operating, regardless of the oil temperature or grade used. A crankcase heater and/or an oil heat exchanger may be needed to meet these requirements.

Failure to follow these lubrication requirements will void the warranty.

The approximate quantities of lubricant required to properly fill the crankcases of each size pump are as follows:

Stroke		Power	U.S.	Inperial	
Inches	mm	End	Gallons	Gallons	Liters
5	127	AXF FXF	3	2-1/2	11-1/2
6	152.4	AXG FXG	4-1/2	3-3/4	17
8	203.2	FXX	12	10	46
10	254	FXD	14	11-3/4	53
10	254	FXE	14	11-3/4	53

FIGURE 2 – LUBRICATION FILL RATE

Oil must be added as required to maintain the level to the top of the street elbow in the end of the frame. Time between oil changes depends upon local conditions. However, if crankcase is kept closed, it should not be necessary to change oil any more than each 1000 working hours.

Jackshaft and eccentric shaft roller bearings are sealed off from the crankcase lubricant and are provided with pressure gun grease fittings. A reliable multipurpose grease NLGI Grade No. 2 should be supplied to these with discretion. Roller bearings WILL HEAT IF TOO MUCH GREASE is used, especially if bearing is completely filled with grease.

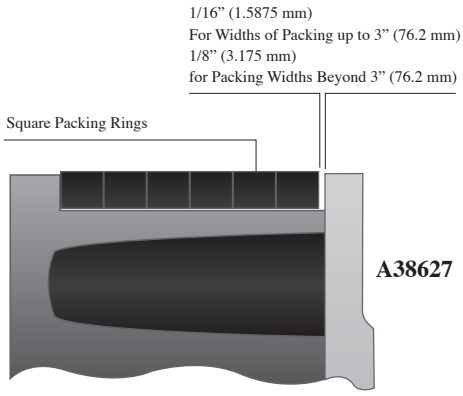

FIGURE 3 – PACKING TYPE PISTON

FLUID PISTONS AND PACKING – Four general types of fluid pistons and packings are used, depending upon operating conditions or requirements. The pumps are packed at the factory complete.

Low Pressure Water or Boiler Feed Service – For low pressure water or boiler feed service, use iron or bronze follower type pistons with fibrous duck and rubber rings having regular or rock hard cure. Regular cure rings are recommended for fluids with temperatures of 180˚ F (82.2˚ C) or lower. Rock hard rings should always be used for fluids with higher temperatures to 250˚ F (121.1˚ C) maximum. Ring lateral clearance between the follower and piston body flange is determined by the amount of packing. Clearance should be 1/16" (1.5875 mm) for 3" (76.2 mm) width packing and under, and 1/8" (3.175 mm) for width beyond 3" (76.2 mm). The rings should be installed with the end stepcut joint gap of 1/32" (.7937 mm) for 3" (76.2 mm) diameter and under, 1/16" (1.5875 mm) for 3" (76.2 mm) to 7-1/2" (190.5 mm), and 1/8" (3.175 mm) beyond 7-1/2" (190.5 mm) diameter. All regular cure and rock hard piston packing should be soaked at least eight hours in warm water before installing.

High Pressure Special Fluid Service – For high pressure water and mildly abrasive fluids, the cup type pistons are recommended. Pistons are available in bronze, steel, iron, monel and stainless steel. Fluids such as acids and alkalis require special cup compositions and should be referred to factory for information.

To assemble the piston to the rod, proceed as follows:

1. Mount the hub to the taper.

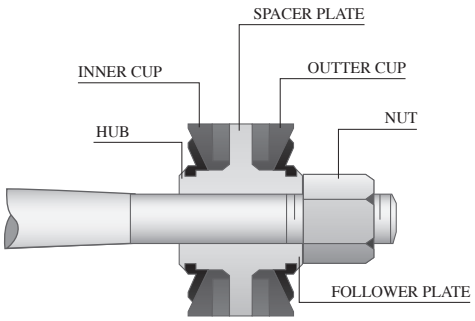

FIGURE 4 – CUP TYPE PISTON

Temperature	Pressure	Texture
–20°F to 212°F (–28.9°C to 100°C)	0 to 125 PSI (0 to 8.79 kg/cm2)	Soft
–20°F to 300°F (–28.9°C to 148.9°C)	100 to 500 PSI (7.03 to 35.15 kg/cm2)	Medium
30°F to 300°F (–1.1°C to 148.9°C)	500 to 1000 PSI (35.15 to 50.31 kg/cm2)	Hard

FIGURE 5 – PISTON TEXTURES

2. Fit cup snugly to the hub.
3. Mount the spacing plate.
4. Mount the outer cup.
5. Mount the follower plate and tighten the nut and locknut securely.

For the texture of the cups, see FIGURE 5.

Clean Oil or Petroleum Products Service (All Pressures) – Solid metal pistons with grooves and metal snap rings or non-metallic rings with expanders are recommended. Piston ring grooves have the proper clearance but it is necessary to check rings for end clearance. Insert each ring in the cylinder liner and check end clearance with a feeler gauge. Metal rings should have from .003" (.076 mm) to .004" (.102 mm) per inch (25.4 mm) of ring diameter and nonmetallic should have from .006" (.152 mm) to .008" (.203 mm) per inch (25.4 mm) of ring diameter.

High Pressure Pistons For Abrasive Service – For high pressure slush service or mud with abrasive particles, a regular oil field rubber type piston is recommended.

High Temperature Service – Consult the Factory for recommendations.

Fluid Piston Rod Packing – Braided synthetic packing is standard for water, oil and general service. Maximum service ratings for this packing are 250 PSI and 250° F.

Molded convex packing is standard for mud service. Maximum rated service temperature is 180° F.

Molded rubber and duck packing is standard for grout and cement service and optional for other services. Maximum rated service temperature is 250˚ F.

Rod packings should always be installed in a clean stuffing box. Each ring should be firmly seated by tamping as it is applied. When box is full, gland nuts should be tightened with a wrench just enough to seat the packing properly; then slacken off and tighten nuts by hand, locking the gland with a final quarter turn with a wrench. DO NOT TIGHTEN GLANDS TOO TIGHT. Some fluids require special packing and should be referred to the factory.

Fluid Piston Rod Baffle – All pumps are supplied with an oil resistant rubber baffle which is mounted on the piston rod between the piston rod stuffing box and the oil stop head. The baffle must be kept in place to prevent foreign material following along the piston rod from the stuffing box into the power end.

⚠ CAUTION

Warranty is void if this baffle is not in place.

Frame Oil Stop Head Packing – Oil stop head packing is cut square fibrous rings. The packing should be inspected frequently and adjusted if necessary. Replace when worn.

Fluid Cylinder Liner Packing – Current liner packing construction consists of two "square rubber hydraulic rings" with a metal spacer between them and is suitable for most services.

⚠ CAUTION

Never tighten liner jack screws while pump is running. If the screws are drawn up too tight, enough pressure can be put on the packing to crush the liner. This ruins the liner, is apt to ruin the piston and can cause piston rod breakage.

Whenever the cylinder head is removed for any reason, the liner jack screws must be backed out. Jack screws should be greased to increase life of screws and cylinder heads and also to prevent rust formation.

When the cylinder head is replaced, the head to cylinder stud nuts should be tightened completely. AFTER the head nuts are tight, the liner jack screws should be adjusted against the liners and the locknuts tightened. Be sure packing is installed under set screw nuts to prevent leakage.

Some pumps are equipped with a clamp located against the end of the liner and serves as a face for the set screws to bear against. For the proper tightening torques refer to torque table, page 18.

FLUID END PARTS – Standard procedure for shipping pumps from the Factory is with valves, pistons, liners, piston rods and packing installed. These fluid end expendable parts are shipped unassembled only when requested by the customer.

FLUID CYLINDER LINERS – Liners should be installed in accordance with instructions given under heading "Fluid Cylinder Liner Packing," page 9. Clean liners thoroughly and grease the outside diameter before installing. Liner jack screws should be tightened as uniformly as possible.

PISTON RODS – Pistons should be assembled on the rod taper. This is important as the outer nut carries the load. Slush service rods use one elastic collar-type locknut per rod. Rods should be threaded into the crosshead as shown in FIGURE 6, leaving approximately one thread of the locknut over the relieved portion of the rod as a protection to the threads.

FLUID VALVES - Valves are easily installed in their individual valve pots. Care should be exercised to tighten the valve cover nuts as uniformly as possible, tightening each nut a little at a time until all are tight. Valve seats and the bore in the deck must be perfectly clean and free from oil or grease.

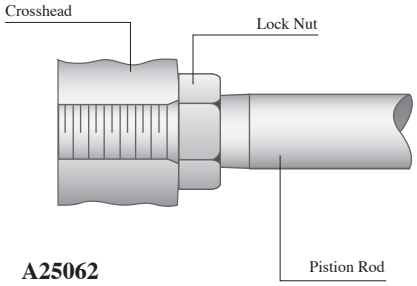

FIGURE 6 – PISTON ROD

Valve seats can be removed with a puller which can be purchased from American Manufacturing Company

STARTING A NEW PUMP – Pumps are shipped from the factory without oil in the crankcase. The hood should be removed and the power end examined and cleaned if necessary. The pump may have been in storage or in the yard for some time and as a consequence dirt may have entered the crankcase. Parts may have been robbed from the pump during storage and not replaced. All nuts and screws should be tightened.

The jackshaft bearings have been supplied with grease at the factory and no grease should be added at this time, unless bearings have been disturbed.

Be sure all valves in the discharge line are open. No valve should be installed between the pump and pressure relief valve in discharge line.

To prevent excessive wear on the fluid pistons and packing when starting, remove a suction valve cover plate on each side of the fluid end and prime the pump. Pump should be started slowly, if possible, and should be operated for several hours with practically no discharge pressure. Check oil level as it may be necessary to add a small quantity of oil to compensate for that adhering to the walls of the crankcase and the moving parts. The pump may then gradually be brought up to full speed and full working pressure. Watch for undue heating or abnormal noise in the working parts. Check all joints in the suction line to be sure there are no air leaks.

Make certain pump is rotating in the correct direction. Refer to FIGURE 7, page 11.

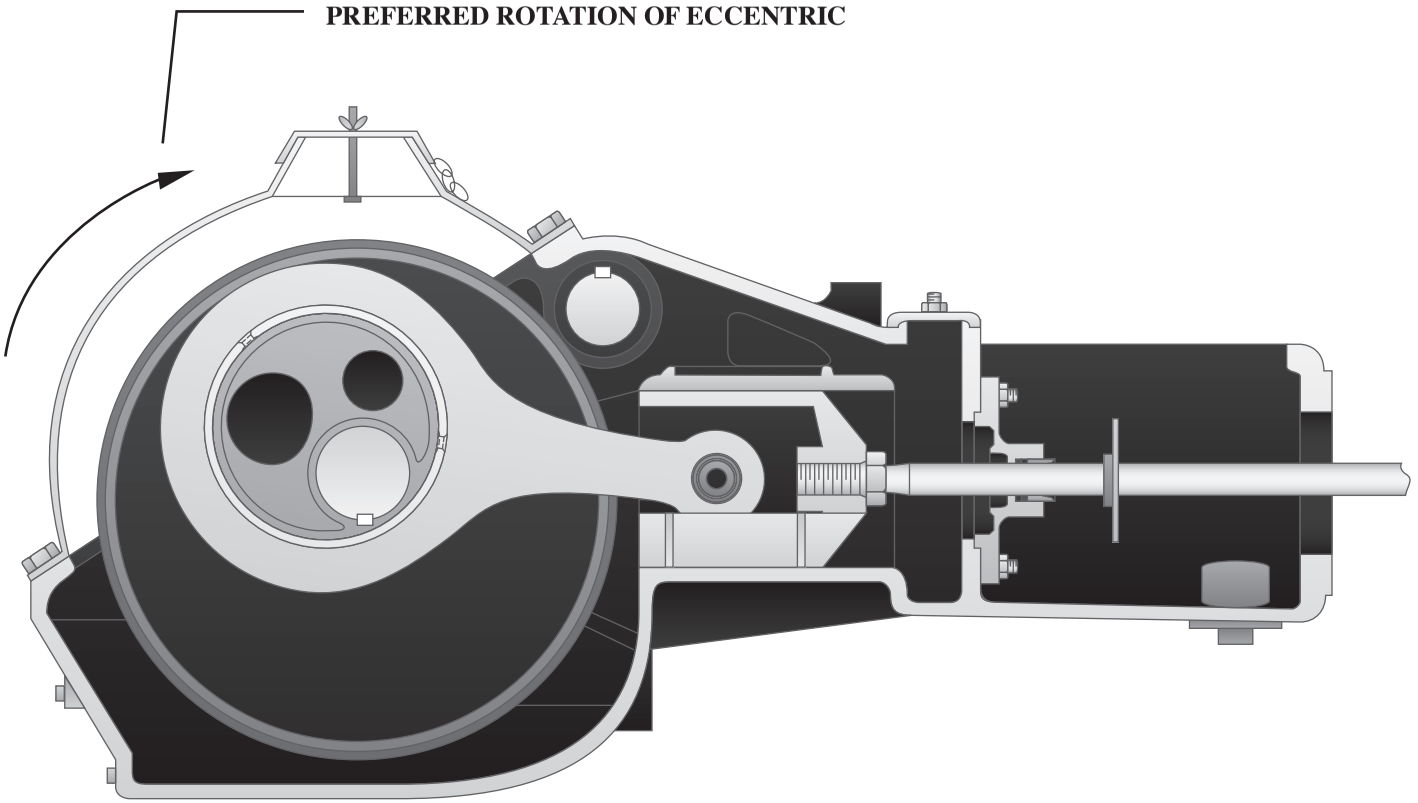

FIGURE 7 – ROTATION OF ECCENTRIC

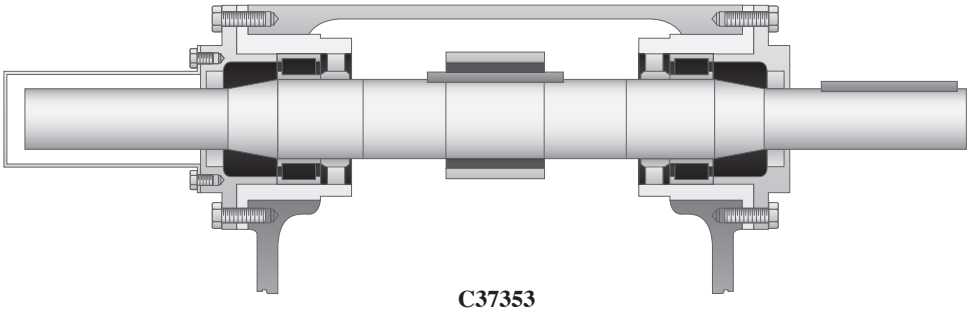

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FIGURE 8 – JACKSHAFT ASSEMBLY

Daily Care – The pump should be kept clean, lubricated properly and stuffing boxes examined daily. With reasonable care, the pump can be expected to give long and trouble-free life.

Occasional Inspection – It is recommended that the fluid valves be examined occasionally to see that excessive wear or cutting has not impaired their efficiency and any damaged or worn parts should be replaced. Fluid end must always be drained when exposed to freezing weather during idle periods.

SERVICE INSTRUCTIONS

Removal of Jackshaft – To remove the jackshaft, it is necessary to remove the bearing housings from both sides of the pump. The bearing outer races and rollers come off with the housings. The bearings inner races and the seal bushings are pressed on the jackshaft and need not to be removed unless replacement is necessary. The jackshaft can be lifted clear of the gear teeth and removed. The jackshaft is not interchangeable end for end, hence, it must be reinstalled in the same way it was removed.

Installation of Jackshaft Oil Seals – The jackshaft roller bearings are provided with a separate inner and outer seal. The correct assembly of these seals is with seal lips facing bearings.

To Remove Crosshead Pin From AXF–FXF & AXG–FXG Pumps – The crosshead pin can be removed from the AXF-FXF and AXG-FXG only by removing the entire gear assembly. To remove the gear and eccentric, it is necessary to remove the main shaft. The main shaft must be removed from the side of the pump in which the end of the shaft contains a 3/4-10 UNC tapped hole. This is the end of the shaft that also contains the main shaft to eccentric key. (See FIGURE 9.) It is advisable to have new shaft seals as these seals can rarely be used the second time. Remove shaft

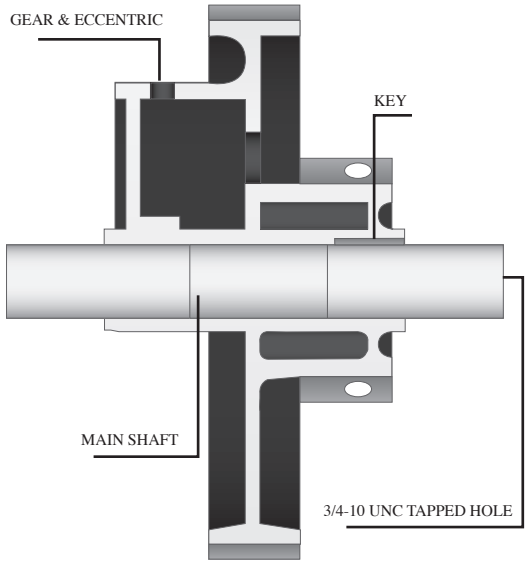

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FIGURE 9 – ECCENTRIC AND MAIN SHAFT ASSEMBLY

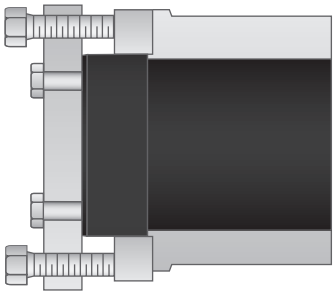

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FIGURE 10 – CROSSHEAD PIN REMOVAL-FXX, FXD, & FXE

through eccentric with hammer and wood block and the bearing cone and seal bushing on the side opposite the tapped hole will slip off the shaft.

The gear assembly with connecting rods and crossheads can all be pulled out through the hood opening after the main shaft has been removed. The piston rods of course must be screwed out of the crossheads before the assembly can be taken from the frame. Crosshead pins are straight and are held in place in the crossheads with set screws.

To Remove Crosshead Pin From FXX, FXD and FXE Pumps – The inspection plates on the sides of the frame should be removed. Two hexagon head cap screws are used to hold the crosshead pin to the crosshead. These are the two screws in the corners of the plate over the crosshead pin. Take these screws out and insert them in the tapped holes in the adjacent corners of the plate and by exerting sufficient pressure with these screws the crosshead pin will come out. A little persuasion with a drift driven against the crosshead near the outer end of the crosshead pin will help.

To remove the gear and eccentric it is necessary to remove the main shaft and piston rods. The main shaft must be removed from the side of the pump in which the shaft contains a ¾-10 UNC tapped hole. This is the end of the shaft that also contains the main shaft to eccentric key. (See FIGURE 9, page 12.) Support eccentric on blocking and drive shaft through eccentric with hammer and wood block. The bearing cone and seal sleeve, on the side opposite the tapped hole, will slip off the shaft.

To Install Main Bearings For All Pumps -

1. Install eccentric with gear teeth in correct position in frame.
2. Install main shaft through opening in frame and through eccentric.
3. Heat and press bearing cones to shaft.
4. Install bearing cups.

NOTICE

There should be no space between the bearing cones and seal bushing or between the seal bushing and eccentric hub.

5. Install gasket and end plate on one side.
6. Take up end plate on other side snugly with cap screws.
7. Check the gap between plate and frame housing with shims. Determine shims required to fill the gap. When you have determined the shims required to fill the gap, remove 0.001 to 0.003 inches (0.0254 to 0.0762 mm) of shims.
8. Remove end plate and install remaining shims.
9. Mount and secure plate.

FXE Main Gear and Eccentric – This pump is constructed with a separate gear bolted to the eccentric. Refer to page 18 for screw torque specifications.

MAINTENANCE OF SPARE REPAIR PARTS – Although operating conditions vary widely, it is suggested that a stock of repair replacement parts be maintained to insure against loss of pump operation. It is considered good practice to keep spare fluid valves, pistons, piston rods, packings, gaskets, etc. on hand. A recommended list of such parts may be secured from American Manufacturing Company Customer Service, the Master Distribution Center (MDC), or your local authorized American Manufacturing Company.

ORDERING OF REPAIR PARTS – Repair parts lists with sectional views are available for any American Manufacturing Company power pump and may be secured from American Manufacturing Company, the Master Distribution Center (MDC), or your local authorized American Manufacturing Company Distributor.

When ordering parts lists or repairs, always give size and serial number of pump. Serial number is stamped on the pump nameplate attached to frame and also on a raised pad located on upper side of the power frame at the fluid cylinder end.

If the serial number cannot be identified, obtain several photographic views of the power frame and fluid cylinders, including part numbers of principal castings which should furnish us clues as to identity of the pump.

SPECIAL CARE OF PUMP IN STORAGE – Piston rod packing and piston packing must be removed, if the pump is not put in service immediately. Permitting packing to remain in an idle pump for a period of time will tend to create rusting and pitting of liner bore and piston rods.

Puller for removing valve seats, liners and crosshead pin bushings may be purchased from American Manufacturing Company distributor.

OPERATING SPEEDS AND PRESSURES – See bulletins for operating speeds and pressures for type of service.

All displacements are theoretical with piston rod volume deducted. For actually delivery deduct from 5% to 10% for slippage using 10% at maximum RPM.

⚠ DANGER

Pressures are maximum permissible with rated maximum piston rod loads and MUST NEVER BE EXCEEDED.

While it is true that reducing the speed reduces the horsepower practically in direct proportion, the piston load for which the pump is designed is a function of the fluid pressure against the piston. Reducing the speed to half and doubling the pressure requires approximately the same horsepower but results in 100% overload on the power end.

Maximum input BHP and shaft RPM shown in bulletins MUST NEVER BE EXCEEDED under any operating conditions. These speeds are recommended for favorable suction conditions and consideration must be given to viscosity and character of fluid.

⚠ CAUTION

DO NOT operate these pumps below 40 RPM as this will hinder proper lubrication.

SECTION 4
DIMENSIONS &RUNNING CLEARANCES

POWER END OIL STOP HEAD DIMENSIONS

Power End Model	Size		Rod Diameter		Stuffing Box Diameter		Net Depth of Stuffing Box	
	Inches	mm	Inches	mm	Inches	mm	Inches	mm
AXF FXF	5	127	15/16	23.8125	1-3/4	44.45	7/8	22.225
AXG FXG	6	152.4	1	25.4	1-13/16	46.0375	7/8	22.225
FXX	8	203.2	1-1/2	38.1	2-1/2	63.5	1-1/8	28.575
FXD	10	254	1-1/2	38.1	2-1/2	63.5	1-5/8	41.275
FXE	10	254	1-1/2	38.1	2-1/2	63.5	1-5/8	41.275

FLUID END PISTON ROD STUFFING BOX DIMENSIONS

Power End Model	* Fluid End Type	Pump size		Rod Diameter		Stuffing Box Diameter		Net Depth of Stuffing Box	
		Inches	mm	Inches	mm	Inches	mm	Inches	mm
AXF FXF	ALL	4 x 5	101.6 x 127.0	15/16	23.8125	1-3/4	44.5	2-1/16	52.3875
AXG FXG	ALL	5 x 6	127.0 x 152.4	1	25.4	1-16/16	46.0375	2-3/8	60.325
FXX FXD FXE	D, H, M, Q, & U	5 x 8 or 5 x 10	127.0 x 203.2 or 127.0 x 254.0	1-1/2 1-1/2	38.1 38.1	2-1/2 2-1/2	63.5 63.5	1-1/8 3-1/8	28.575 79.375
FXX FXD FXE	B, C, F, G, K, L, P, S, & T	5 x 8 or 5 x 10	127.0 x 203.2 or 127.0 x 254.0	1-1/2 1-1/2	38.1 38.1	2-1/2 2-1/2	63.5 63.5	1-1/8 3-1/8	28.575 79.375
FXX FXD FXE	A, E, J, N, & R	5 x 8 or 5 x 10	190.5 x 203.2 or 190.5 x 254.0	1-1/2 1-1/2	38.1 38.1	2-1/2 2-1/2	63.5 63.5	1-1/8 3-1/8	28.575 79.375

* Refer to Unit Nameplate and Parts List Manual Matrix, Colum 4, for Fluid Cylinder Descriptions.

DATA FOR FXD, FXE, AND FXX POWER PUMPS

RECOMMENDED RUNNING CLEARANCES (Actual dimensions are for new pumps and are possible cumulative tolerances.) (Condemnable indicates replacement necessary.)	POWER END AND STROKE							
	FXD & FXE 10 in. (254.0 mm) Stroke				FXX 8 in. (203.2 mm) Stroke			
	Inches		mm		Inches		mm	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
a. ROLLER TYPE MAIN BEARINGS Refer to Page 13. Bearing Preload Condemnable when pitting, scaling, mis-alignment, excessive wear or noise occurs.	.001T	. 025T	.025T	.076T	.001T	.003T	.025T	.076T
b. CONNECTING ROD LINER TO ECCENTRIC Actual Feeler Gauge Condemnable when liner knocks or clearance equals	.011 .010 .040	.022 .021	.279 .254 1.016	.559 .533	.007 .006 .035	.014 .013	.229 .203 .889	.432 .406
c. CROSSHEAD PIN Feeler Gauge Condemnable - Replace pressed-in type bushings when a 0.006” (.152 mm) feeler gauge can be inserted between the pin and bushing or when the crosshead pin knocks.	.0015	.002	.038	.051	.0015	.002	.038	.051
d. CROSSHEAD OR SHOE TO FRAME Actual Feeler Gauge Condemnable when crosshead knocks or clearance equals	.005 .004 .060	.013 .012	.127 .102 1.524	.330 .305	.005 .004 .060	.013 .012 1.524	.127 .102	.330 .305
e. JACKSHAFT ROLLER BEARING Condemnable between roller and race .016 -.018” (.406 - .457 mm).								
GEAR RATIO	**6.0**				**4.71**			

DATA FOR AXG–FXG AND AXF–FXF POWER PUMPS

RECOMMENDED RUNNING CLEARANCES (Actual dimensions are for new pumps and are possible cumulative tolerances.) (Condemnable indicates replacement necessary.)	POWER END AND STROKE							
	AXG–FXG 6 in. (152.4 mm) Stroke				AXF–FXF 5 in. (127.0 mm) Stroke			
	Inches		mm		Inches		mm	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
a. ROLLER TYPE MAIN BEARINGS Refer to Page 13. Bearing Preload Condemnable when pitting, scaling, mis-alignment, excessive wear or noise occurs.	.001T	. 003T	.025T	.076T	.001T	.003T	.025T	.076T
b. CONNECTING ROD LINER TO ECCENTRIC Actual Feeler Gauge Condemnable when liner knocks or clearance equals	.007 .006 .030	.015 .014	.178 .152 .762	.381 .356 .030	.007 .006 .030	.014 .013 .762	.152 .127	.356 .330
c. CROSSHEAD PIN Feeler Gauge Condemnable - Replace pressed-in type bushings when a 0.06” (.152 mm) feeler gauge can be inserted between the pin and bushing or when the crosshead pin knocks.	.0005	.0010	.0127	.0254	.0005	.0010	.0127	.0254
d. CROSSHEAD OR SHOE TO FRAME Actual .003 Feeler Gauge Condemnable when liner knocks or clearance equals	.010 .002 .060	.076 .009	.254 .051 1.524	.003 .229	.010 .002 .060	.076 .009 1.524	.254 .051	.229
e. JACKSHAFT ROLLER BEARING Condemnable between roller and race .016 -.018” (.406 - .457 mm).								
GEAR RATIO	**4.72**				**4.88**			

TORQUE SPECIFICATIONS

Power End Model	FXD_ FXE_ FXX_		FXD_ FXE_ FXX_		FXD_ FXE_ FXX_		AXF–FXF AXG–FXG	
*** FLUID CYLINDER TYPE (Column 4 of Matrix)**	A E J N R		B C F G K L P S T		D H M O U		ALL	
	ft-lbs	kg-m	ft-lbs	kg-m	ft-lbs	kg-m	ft-lbs	kg-m
Fluid Cylinder to Frame Connecting Stud Nuts	210	29.0	590	81.6	590	81.6	260	36.0
Fluid Cylinder Head Stud Nut	—	—	—	—	590	81.6	—	—
Fluid Cylinder Liner Set Screw	25	3.5	25	3.5	25	3.5	25	3.5
Suction Manifold to Fluid Cylinder	—	—	—	—	260	36.0	—	—
Discharge Manifold to Fluid Cylinder	—	—	—	—	260	36.0	—	—
Suction Manifold Flange Nut	260	36.0	260	36.0	260	36.0	150	20.7
Discharge Manifold Flange Nut	260	36.0	—	—	800	110.6	150	20.7
Piston Rod Nut (Slush-Proof Nut)	525	72.6	525	72.6	525	72.6	260	36.0

	FXE ONLY	
	ft-lbs	kg-m
Main Gear to Eccentric Screw	75	10.4

* Refer to Unit Nameplate and Parts List Manual Matrix, Colum 4, for Fluid Cylinder Descriptions.

LOCATING TROUBLES

Failure To Deliver Required Volume:

(a) Pump not primed
(b) Insufficient speed
(c) Fluid liner worn
(d) Suction lift too high
(e) Air leaks in suction or stuffing boxes
(f) Foot valves too small or clogged
(g) Suction pipe not immersed deep enough
(h) Fluid piston packing worn
(i) Fluid valves worn
(j) Insufficient prime mover horsepower
(k) Piston loose on rod

Pump Vibrates:

(a) Fluid pistons improperly packed
(b) Foundation not sufficiently rigid
(c) Fluid piston packed too tight
(d) Fluid valves improperly seated
(e) Improper discharge line

Pump Noisy Fluid Valves:

(a) Usually due to air leaks or failure of fluid end to completely fill due to faulty suction conditions
(b) Valves not seating tightly

Failure To Create Rated Pressure:

(a) Insufficient prime mover horsepower
(b) Slippage in drive
(c) High back pressure
(d) Piston rings in fluid end binding
(e) Piston improperly packed
(f) Valves not holding
(g) Leakage past fluid piston rings
(h) Leakage past liner packing
(i) Liners worn

Pump Loses Capacity After Starting:

(a) Leaky suction line
(b) Suction lift too great
(c) Entrained vapors in the fluid, especially if fluid is warm

AMERICAN MANUFACTURING COMPANY

AX SERIES DUPLEX POWER PUMPS

WARRANTY

GENERAL PROVISIONS AND LIMITATIONS

American Manufacturing (the "Company") warrants to each original retail purchaser ("Purchaser") of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship provided that no warranty is made with respect to:

1. Any product which has been repaired or altered in such way, in the Company's judgment, as to affect the product adversely.

2. Any product which has, in the Company's judgment, been subject to negligence, accident, improper storage, or improper installation or application.

3. Any product which has not been operated or maintained in accordance with the recommendations of the Company.

4. Components or accessories manufactured, warranted and serviced by others.

5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted directly to the manufacturer.

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours any part which in its judgment proved not to be as warranted within the applicable Warranty Period. During the first 90 days after start-up, not to exceed 120 days after delivery, a new part or a repaired part along with the labor for installation of such new or repaired part will be provided. Such parts and labor will be provided without charge to the user during normal working hours at the Company's or authorized distributor's service facility. All costs of transportation of product or parts claimed not to be as warranted and of repaired or replacement parts to or from such service facility shall be borne by the Purchaser. The Company may require the return of any product or part claimed not to be as warranted to one of its facilities as designated by Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of this warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components thereof.

WARRANTY PERIOD

Except for the products or components listed below, the Warranty Period for all products is 1,250 hours of operation or three (3) months after start-up, not to exceed 120 days after delivery to the Purchaser, whichever occurs first. The expectations are as follows:

Power end is warranted for twelve (12) months for date of start-up or eighteen (18) months from the date of delivery to the Purchaser, whichever occurs first.

Expendable fluid end parts, including, but not limited to, valves, valve parts, packing, liners and pistons, are not covered by this warranty due to variable abrasive nature of material pumped.

DISCLAIMER

THE COMPANY MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER EXPRESSED OR IMPLIED AND ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY THE COMPANY. THE COMPANY SHALL IN NO CASE BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES WHATSOEVER WITH RESPECT TO PRODUCTS OR SERVICES MANUFACTURED OR FURNISHED BY IT OR ANY ACTS OR OMISSIONS RELATING THERETO. THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO THE PURCHASER. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 business days after the date upon which the product is claimed not have been warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.